NOTICE OF CHANGE

MILITARY STANDARD
FUZE AND FUZE COMPONENTS,
ENVIRONMENTAL AND PERFORMANCE TESTS FOR

TO ALL HOLDERS OF MIL-STD-331B:

1. THE FOLLOWING PAGES OF MIL-STD-331B HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
v	1 May 1991	v	1 December 1989
vi	1 December 1989	vi	REPRINTED WITHOUT CHANGE
vii	1 May 1991	vii	1 December 1989
viii	1 December 1989	viii	REPRINTED WITHOUT CHANGE
3	1 May 1991	3	1 December 1989
4	1 December 1989	4	REPRINTED WITHOUT CHANGE
11	1 May 1991	11	1 December 1989
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16	1 May 1991	16	1 December 1989
A4-1 thru A4-4	1 May 1991	A4-1 thru A4-4	1 December 1989
C8-3	1 December 1989	C8-3	REPRINTED WITHOUT CHANGE
C8-4	1 May 1991	C8-4	1 December 1989
E5-1 thru E5-4	1 May 1991	None	NEW PAGES

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-331B will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or canceled.

Custodians:
Army - AR
Navy - OS
Air Force - 99

Review activities
Army - EA, MI, MT, TE

Preparing activity:
Army - AR

(Project 13GP-0020)

AMSC N/A

FSC 13GP

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CONTENTS - Continued.

FIGURES

FIGURES - Continued

TABLES

MIL-STD-45662	Calibration Systems Requirements	All

(Unless otherwise indicated, copies of federal and military specification, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government documents, drawings and publications. The following other Government documents, drawings and publications form a part of this standard to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

	DRAWINGS	Test
74-2-83 (Army)	Primer, M55	D4
81-3-35 (Army)	Machine, Jumble Testing, Assembly	A2
81-3-56 (Army)	Test Holder, Piecemark G4	D4
8-3-150 (Army)	Ball Drop Tester	D4
9 255 299 (Army)	Jolt Machine	A1
8 797 250 (Army)	Fixture for Lead Disc Test Assembly and Gage	D4
9 297 939 (Army)	Spotting Charge (Model APG-2)	D3
40 897 (Navy)	Drop Tower Construction	A4
LD 166 538 (Navy)	Test Set Mk 136 Mod 0	D4
LD 267 078 (Navy)	Life Test Equipment (VSP Box)	
QEL 1386-1, -45 (Navy)	Jumble Machine	A2
QEL 1387-1 (Navy)	Jumble Machine Modification	A2
OS 6341 (Navy)	General Ordnance Design Requirements	C6
TECHNICAL MANUALS		
OD 7547 (Navy)	Vacuum-Steam-Pressure Accelerated Aging Chamber.	C2
TM 10-500-53 (Army) & TO 13C7-18-41 (Air Force)	Airdrop of Supplies and Equipment: Rigging Airdrop Platforms	E5

(Copies of drawings and publications required by contractors for specific acquisitions should be obtained from the contracting activity.)

2.2 Non-Government publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.5).

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)		Test
ASTM-G-21	Standard Practice for Determining Resistance of Synthetic Polymeric Material to Fungi	C5
ASTM-G-22	Standard Practice for Determining Resistance of Plastics to Bacteria	C5
ASTM-A-108	Steel Bars, Carbon, Cold-Finished, Standard Quality	D4, B2
ASTM-A-109	Steel, Carbon, Cold-Rolled Strip, Specification for (ANSI G 47.1-72)	B2
ASTM-C-208	Insulating Board (Cellulosic Fiber) Structural and Decorative	D1
ASTM-E-380	Metric Practice	All
ASTM-B-880	Incline Impact Test for Shipping Containers	A5, B2

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

The following definitions of terms used within this standard are intended to provide better application of this standard to all elements of fuzing.

3.1 Alternate test. A test procedure which no longer represents standard test philosophy. Alternate test procedures are retained in Section 6 of the individual test. They apply only to fuzes designed prior to publication of the current standard procedure.

3.2 Arm. To make a fuze ready to function.

a. If the fuze employs explosive train interruption, the fuze is armed when the interruption is removed or when the explosive train elements are brought into functional alignment.

b. If explosive train interruption is not employed, a fuze is armed when minimum functioning energy is available and only a firing stimulus is required to deliver the energy to the initiator.

Table 5-1. Test Number Conversion.

If specification references the test indicated below,	then use sections 1 thru 5 of the test indicated below unless otherwise specified.
101.3	A1
102.2	A2
103.2	A3
104 or 401	B1, Section 6.1
105.1	C1
106.1	C2
107.1	C3
108	C4
109.1	Deleted
110.1	C5
111.1	A4
112.1	C6
113.1	C7
114 or 402	B2, Section 6.1.1 (5 to 500 Hz vibration), and A5, Section 6.1.2 (rough handling)
115.3	D1
116.1	C9
117	E5
118	C8
119 or 404	B1, Section 6.2
120 or 403	B2, Section 6.2 (5.5 - 200 Hz vibration), and A5, Section 6.2 (rough handling)
121	Deleted
122	B3
123	B1
124	B2
125.1	A5
126	F1
201 thru 205	E1
206	E2
207	Now part of D2
208.2	D2
209	E3
210.1	D3
211 or 406	Deleted; replaced by US Army TOP 7-2-506 and -509
212	E4
213 or 405	Deleted; replaced by US Army TOP 7-2-506 and -509
301 thru 303	D4

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Background information. The tests contained in this standard have been developed over a period of years by designers and users of fuzes. Although they were developed based on functional aspects unique to fuzes, many of the tests have been specified in the development and procurement of other ordnance components and test equipment. Application of many tests appears to be limited only by the physical capacity of the test facilities; however, careful consideration should be given to various aspects of these tests before they are specified.

6.1.1 Safety. The first aspect is the requirement of safety, due to the direct presence of explosives in the fuze or in the concommitant effect of the fuze on associated explosives in the operational sequence of the weapon. The tests shall reflect complete safety in test conduct, as well as establish that the fuze design achieves the safety attributes which are required for service use.

6.1.2 Short operational time. The second functional aspect is the short operational time of a fuze in relation to the comparatively longer operational time and service life of the complete weapon. Each test shall be devised to provide the full extraction of information on fuze performance under such restrictive operational conditions.

6.1.3 One-time operation. The third functional aspect is the one-time life of a fuze, a condition which is coincident with the previously stated aspect of short operational time. The one-time performance tests in many instances cause destruction of the test item or components of the test item, thus restricting subsequent analysis. The test design shall anticipate and provide for the maximum return of information under such conditions.

6.2 Test content and format. Each test is prepared in a standardized format divided into seven sections: purpose, description, criteria for passing test, equipment, procedure, alternate or optional tests, and related information. The first five sections contain all essential information for setting up and conducting the test and are mandatory for compliance with this standard. Alternate or optional tests in Section 6 may be specified by the test directive. Related information is not mandatory; it is intended to provide background to the test. The content of each test section is described below.

6.2.1 Purpose. The purpose of each test shall contain the following information:

6.2.1.1 Location. The test shall be identified as a laboratory test or field test.

6.2.1.2 Safety, reliability or performance. Tests which determine if the fuze is safe for use or disposal shall be identified as safety tests. If fuze arming or functioning is required either by procedures within the test or by conducting a separate test, the test shall be regarded as a reliability test. If the test quantitatively measures the operational parameters of the fuze, it shall be identified as a performance test.

6.2.1.3 Life cycle phase. Identify the fuze life cycle phase which is the subject of the test. These include storage, handling, transportation, preparation for use or any combination of these.

6.2.1.4 Environment or performance measurement. State the specific conditions of the test such as exposure to extreme temperature, vibration, and so forth, the performance characteristic being measured such as arming distance.

Standard	Other
hr - hours	kn - knots
s - seconds	rpm - revolutions per minute
min - minute	rps - revolutions per second
g - gravity units	
° - degrees	

Standard caliber sizes or other units of measure normally specified in English or metric have not been converted. Examples include 5-in or 76-mm guns and pressure expressed in millimeters of mercury.

6.4 Test parameters. Table 6-1 provides a summary of test parameters for MIL-STD-331. These include the purpose of the tests, environments investigated, criteria for passing the tests, configuration of the fuze or fuzed munition, location, and whether or not the test is normally performed during development or production.

6.5 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1, and 2.2).

6.6 Subject term (key word) listing.

Aircraft munitions tests
Arming tests
Climatic tests
Drop tests
Electric influence tests
Functioning tests
Jolt tests
Jumble tests
Magnetic influence tests
Safety tests
Shock tests
Transportation tests
Vibration tests

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Table 6-1. Test Parameters.

Group	No.	Title	Purpose 4	Environment 6	Criteria for Passing Test	Munition 11	Packaged	Loc.	Used 2
Mechanical Shock	A1	Jolt	S	T	Safe for use 3	None	No	Lab	D, P
	A2	Jumble	S	T	Safe for use 3	None	No	Lab	D, P
	A3	12-m Drop	S	H	Safe for disposal	None,I,L	14	17	D, P
	A4	1.5-m Drop	S,R,P	H,U	Safe for use 15	None,I,L	No	17	D, P
	A5	Transportation-Handling	S,R,P	H,U	Operable	None,I,L	Yes	Lab	D, P
Vibration	B1	Transportation Vibration	S,R	T	Operable	None	No	Lab	D, P
	B2	Transportation Vibration	S,R	T	Operable	None,I,L	Yes	Lab	D, P
	B3	Tactical Vibration	S,R	U	Operable	None	No	Lab	D, P
Climatic	C1	Temperature & Humidity	S,R	S	Operable	None	No	Lab	D, P
	C2	Vacuum-Steam-Pressure	S,R	S	Operable	None	No	Lab	D
	C3	Salt Fog	S,R 5	S	Operable 5	None	No	Lab	D
	C4	Waterproofness	S,R	S,H	Operable 7	None	No	Lab	D,P
	C5	Fungus	S,R	S	Operable	None	No	Lab	D
	C6	Extreme Temperature	S,R	S	Operable	None	No	Lab	D,P
	C7	Thermal Shock	S,R	S	Operable	None	No	Lab	D,P
	C8	Leak Detection	P	S	1	None	No	Lab	D,P
	C9	Dust	S,R	S,H,U	Operable 8	None	No	Lab	D
Safety, Arming & Functioning	D1	Primary Explosive Component Safety	S	S,H,T,U	9	None	No	Lab	D,P
	D2	Projectile Fuze Arming Distance	S,P	U	1 10	I,L	No	Field	D,P
	D3	Time to Air Burst	P	U	1	I,L	No	Field	D,P
	D4	Explosive Component Output	P	U	1	None	No	Lab	D,P
	D5	Rain Impact 16	16	U	16	16	No	16	D
Aircraft Munition	E1	Jettison	S	U	Safe for disposal 12	L	No	Field	D
	E2	Low Altitude Accidental Release	S	U	Safe for disposal 12	L	No	Field	D
	E3	Arrested Landing Pull-off	S	U	Safe for disposal 12	L	No	Field	D
	E4	Catapult and Arrested Landing Forces	S,R	U	Operable	L	No	Field	D
	E5	Simulated Parachute Air Delivery	S, R	H, T, U	Operable 18	None, I	Yes	Field	D
Electric & Magnetic Influence	F1	Electrostatic Discharge	S,R	H,T,U	Safe for use 13	None	14	Lab	D,P
	F2	Electromagnetic Pulse 16	S,R	S,H,T,U	Operable, 1	16	No	Lab	D
	F3	EED Susceptibility to EMR 16	S,R	16	16	16	16	Lab	D
	F4	Lightning 16	S,R	U	16	16	No	Lab	D

Notes: 1. Specified in the test directive. 2. Normal application: D = development; P = production. 3. No detonation of explosive components. 4. S = safety, R = reliability, P = performance. 5. The fuze is not required to operate after a 96-hour test. 6. S = storage, T = transportation, H = handling, U = use. 7. No evidence that water has entered fuze. 8. Inspection ports and labels must be clear when dust is wiped away. 9. No detonation beyond interrupter. No ejection of parts. No other hazards. 10. In muzzle safety test, no detonation permitted beyond last safety device. 11. None = test conducted without munition, I = inert round or spotting charge, L = live round. 12. No detonation of warhead attributed to fuze. 13. Fuze must also be operable after human body discharge and air replenishment discharge (packaged) tests. 14. Test contains requirements for both bare and packaged fuzes. 15. Test directive may optionally specify that the fuze be operable. 16. Test in preparation; information to be determined. 17. Drop facility may be located in a laboratory or at an outdoor field test site. 18. At the completion of the malfunctioning test, the fuze must be safe for disposal.

TEST A4.1

ONE AND ONE-HALF METER (FIVE-FOOT) DROP

1. PURPOSE

This is a laboratory safety and reliability test simulating handling and tactical conditions. Each unpackaged fuze or fuzed munition must be able to withstand the required number of 1.5 m (5 ft) drops onto a steel plate.

2. DESCRIPTION OF TEST

2.1 General. This test simulates severe shocks encountered during accidental mishandling in manufacture, transportation, or service use of fuzes. As examples, fuzes or fuzed munitions may fall off a conveyor belt or truck or be dropped during weapon loading. Either bare fuzes or fuzes mounted in a suitable, inert-loaded munition are dropped 1.5 m (5 ft) onto a steel plate which is solidly supported by gravel or concrete. The equipment shall provide an unimpeded free-fall drop of 1.5 m (5 ft), or a velocity of 5.5 m/s (18 ft/s) prior to the fuze striking the plate and rebounding. There are five required impact orientations: (1) nose down, (2) base down, (3) horizontal, (4) 45° nose down, and (5) 45° base down. The test directive shall specify which of the following procedures shall be used.

2.1.1 Two-drop procedure. The fuzes are dropped at least twice so that all combinations identified in Table A4-1 are tested. The developer, tester or evaluator and service review authority may consider a single drop in one or more orientations adequate to meet the requirements of this test provided an in-depth safety analysis or preliminary test results show conclusively that, after one drop in some orientation, the fuze is obviously damaged beyond use and the safety features have not been compromised. Two drops are required in all other cases.

Table A4-1. Two-drop Test Schedule.

Sample No.	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	21 22 23 24 25
First Drop	A A A A A	B B B B B	C C C C C	D D D D D	E E E E E
Second Drop	A B C D E	A B C D E	A B C D E	A B C D E	A B C D E

Legend:
A - nose down; B - base down; C - horizontal; D - 45° nose down; E - 45° base down

2.1.2 Single-drop procedure. For those test items whose cost or availability preclude testing 25 items, such as some missile fuzes and safety and arming devices, a minimum of five fuzes or inert fuzed munitions shall be dropped once each, one at each orientation described above. A second drop shall be optional.

2.2 Fuze configuration. Fuzes shall be tested at ambient temperature. All fuze explosive components shall be present and fuze safety features in use during the test. An inert lead and booster may be substituted for live components during production acceptance testing, when permitted by the item specification, or when use of a live booster constitutes an excessive hazard. The inert lead and booster components shall have an equivalent weight and configuration.

2.3 Use of a munition. The fuze shall be tested as a separate item or attached to the inert munition for which it is intended, depending on the normal method of shipment. If the fuze is shipped both separately and attached to its munition, it shall be tested both ways. For tests involving the use of an inert projectile, rocket, bomb and so forth, the munition shall closely simulate the weight, consistency and weight distribution of the replaced explosives. When a munition exceeds 250 kg (550 lbs), the fuze may be attached to a test vehicle which weighs at least 250 kg (550 lbs). For rockets or guided missiles more than 1.5 m (5 ft) in length, use an inert test vehicle at least 1.5 m (5 ft) long. Fuzes that could be used in a variety of munitions should be mounted on the munition which will provide the most severe environment based on the safety analysis or preliminary testing.

2.2 Applicable publications. All standards, specifications, drawings, procedures and manuals which form a part of this test are listed in Section 2 of the introduction to this standard. Special attention is directed to Navy Bureau of Yards and Docks Drawing No. 40897, Drop Tower Construction, which describes an optional test fixture.

2.3 Test documentation. Test plans, performance records, equipment, conditions, results, and analysis shall be documented in accordance with Section 4.8 of the general requirements to this standard.

3. CRITERIA FOR PASSING TEST

3.1 Fuze condition. The development test plan or product specification shall specify one of the pass/fail criteria stated below. In general, nose-mounted fuzes dropped in any of the nose down positions, and protruding base fuzes dropped in any of the base down positions must be safe to use, but are not required to be operable.

3.1.1 Safe to use. At the completion of this test, the fuze shall be safe for transportation, storage, handling and use in accordance with Paragraph 4.6.2.1a of the general requirements to this standard. The fuze does not have to be operable.

3.1.2 Safe to use and operable. At the completion of this test, the fuze shall be safe for transportation, storage, handling and use, as well as operable in accordance with Paragraphs 4.6.2.1a and 4.6.2.2 of the general requirements to this standard.

3.2 Decision basis. Breakdown, inspection, other appropriate tests and engineering judgment shall form the basis for the decision that fuzes have passed or failed the test.

4. EQUIPMENT

4.1 Drop fixture. The 1.5 m (5 ft) height required for this test can be obtained by using a steel tower, derrick or a horizontal beam extending from an existing structure. Navy Bureau of Yards and docks Drawing No. 40897, shows the construction of a typical drop tower. The fixture should allow a quick release which does not disturb the orientation of the item at the moment of drop.

4.2 Impact plate. The steel plate upon which impact occurs shall have a minimum thickness of 75 mm (3 in), a Brinell hardness of 200 or greater, and shall be solidly supported in a horizontal plane over its entire bearing area by a minimum thickness of 0.6 m (2 ft) of gravel or concrete. The surface of the impact plate shall be flat having length and width at least one and one-half (1 1/2) times the maximum dimension of the test item being dropped. The plate shall be surrounded on all four sides by an enclosure of sufficient height and strength to contain the rebounding test item.

4.3 Guidance system. Various guidance systems may be employed to ensure the correct impact angle. For example, a vertical steel tube may be used for guiding nose or base impact. However, any guidance shall be positioned high enough above the striking plate to allow unimpeded fall and rebounding.

4.4 Other equipment. Other supporting equipment, such as temperature conditioning equipment, an electric hoist, a remotely controlled release, and a fuze recovery work table are recommended.

5. PROCEDURE

5.1 Test setup. Prepare the test equipment as described in Sections 2 and 4. Refer to the test directive and configure the test items using live or inert boosters and bare fuzes or fuzes mounted to an appropriate munition.

5.2 Fuze orientation. The test item shall be oriented to impact: (1) nose down, (2) base down, (3) horizontal, (4) 45° nose down, and (5) 45° base down. The tolerance from the required orientations shall be ± 10 degrees. For drops other than nose or base down, orient the test item to expose the most critical or vulnerable plane of the fuze to impact. This is determined by engineering judgment or past experience with the design. The orientations of the test item shall be recorded.

5.3 Drop. Drop the test item 1.5 m (5 ft) (lowest point of the test item to point of impact) or achieve an impact velocity of 5.5 m/s (18 ft/s) ± 5%. Each test item shall be dropped twice in accordance with Table A4-1 unless the single-drop test described in Paragraph 2.1.2 has been specified in the test directive.

5.4 Recovery. Before handling, examine the dropped assembly for visible evidence of unsafe conditions. Recover the fuze using approved recovery methods.

5.5 Safety compliance. Inspect each fuze to determine that it is safe to use in accordance with Paragraph 4.6.2.1a of the general requirements to this standard.

5.6 Continue testing. Continue testing the specified number of items. The test munition and steel impact plate may be reused as long as they are not damaged or work hardened to the extent that they influence further tests.

5.7 Operational compliance. If operation of the fuze is specified by the test directive, perform appropriate additional tests and evaluate the results in accordance with Paragraph 4.6.2.2 of the general requirements to this standard.

6. ALTERNATE AND OPTIONAL TESTS

6.1 Extreme temperature. Preconditioning fuzes to extreme temperatures such as +71°C (+160°F) and -54°C (-65°F) may be specified as additional requirements.

6.2 Impact surface. Soft earth, water, fiberboards, or similar substances may be specified during fuze development, if the fuze is considered to be more vulnerable to a shock of low peak acceleration and long duration.

6.3 Drop height. Drop testing at different heights, such as, 2.1, 3.0, 3.7, and 4.5 m (7, 10, 12, and 15 ft) may be specified as additional requirements.

6.4 Fuze safety features. The test may be performed with each safety feature alternately disabled to demonstrate the ability of remaining safety features to provide independent safety.

7. RELATED INFORMATION

None.

4.3 Bubble method. A transparent-wall vacuum vessel large enough to hold the test fuze; a system for partially filling the vessel with an appropriate test liquid (for example, water containing a wetting agent) to cover the fuze; vacuum equipment for evacuating the space above the liquid to a pressure of 250 mm of mercury (mm Hg); a gage to indicate the vacuum during the test; and equipment for lowering and raising the fuze into and out of the test liquid. See 6.5 for recommendations.

4.4 Safety equipment. Safety features and precautions must be established which consider the possibility of failure of the pressure vessel or a sudden structural failure of the fuze with release of pressure and violent expulsion of fuze parts or inadvertent initiation of explosives which may be in the fuze.

5. PROCEDURE

5.1 Fine Leak Test.

5.1.1 Fuze with test port - filled or not filled. Either the halogen or helium gas method may be used depending on equipment availablilty or the individual fuze specification. The equipment used must be calibrated with the appropriate leak standard before performing the test.

5.1.1.1 Halogen gas method. If the fuze is or is not filled with a tracer gas, and has a test port or tube leading to the internal cavity, connect the test port or tube to a source of halogen gas. Pressurize the fuze cavity to 0.1 MPa (15 psig) with a halogen gas. Use the probe of the halogen leak detector, with the instrument set on its highest sensitivity scale to inspect all surfaces, joints and seals of the fuze. If leakage is observed, the sensitivity range must be varied until the rate of leakage is determined.

5.1.1.2 Helium gas method. If the fuze is or is not filled with a tracer gas and has a test port or tube leading to the internal cavity, place the fuze in the vacuum test chamber of the mass spectrometer leak detector. Connect the test port or tube to a vacuum pump and a source of helium. Evacuate the fuze to a pressure of 50 $\pm$ 10 mm Hg absolute, and then close the valve to the pump. Pressurize the fuze cavity to 0.1 MPa (15 psig) with helium. Operate the leak detector and observe for leakage.

5.1.2 Fuze with no test port - tracer or gas-filled. Either the halogen or helium gas method may be used depending on equipment availability or the individual fuze specification. The equipment used must be calibrated with the appropriate leak standard before performing the test.

5.1.2.1 Halogen gas method. If the fuze is filled with a halogen tracer gas, the fuze shall be inspected over its surfaces, joints, and seals using the probe of a halogen leak detector. The instrument shall be set on a sensitivity scale to indicate a leak rate of 1×10^{-7} atm cc/s. Unless the concentration of the halogen gas is known, any indication of leakage is unacceptable. A supplementary gross leak test shall be performed if an acceptable leak rate is indicated during this gas test.

5.1.2.2 Helium gas method. If the fuze is filled with helium as a tracer gas, place the fuze in the mass spectrometer leak detector test chamber. Operate the equipment to evacuate the test chamber and observe for leakage. A supplementary gross leak test shall be performed if an acceptable leak rate is indicated during this gas test.

5.1.3 Fuze with no test port - not filled. The mass spectrometer used must be calibrated with the appropriate leak standard before performing the test.

5.1.3.1 Helium gas method. If the fuze is sealed without a trace gas, and neither a test port nor an entrance tube is provided, place the fuze in a pressure vessel. Close the vessel and decrease the pressure to less than 50 mm Hg absolute to remove air from the vessel. No holding time is required. Increase the pressure to 0.100 ± 0.003 MPa (15 ± 0.5 psig) using helium. Maintain the pressure for 4 ± 0.1 hr. Reduce the pressure to atmospheric conditions, open the vessel and remove the fuze. Flush the exterior of the fuze with compressed air. Within 15 minutes after reduction of the pressure from 0.1 MPa (15 psig), place the fuze in the mass spectrometer test chamber and observe for leakage. The internal free gas volume or cavity of the fuze has a direct effect on the attainable sensitivity of this procedure because of the variability of the resulting helium concentration inside the fuze. The duration of pressurization given is for a fuze with an internal free air volume of about one cc (0.06 cu in). The mass spectrometer leak test shall be operated on a scale setting sensitive enough to detect leak rates of 1 x 10^{-8} atm cc/s. The procedure then will detect a leak rate of approximately 1 x 10^{-6} atm cc/s. The pressurization duration shall be increased to 12 hours for fuze internal free gas volumes between 1 and 5 cc, and to 24 hours for gas volumes between 5 and 10 cc. Larger internal gas volumes will require longer pressurization durations which may not be practical. See paragraph 6.3 and reference 7.3 for further information. Any indication of leakage is unacceptable. A supplementary gross leak test shall be performed if an acceptable leak rate is indicated during this test.

5.2 Gross leak test.

5.2.1 Bubble method. Place the fuze in a transparent wall pressure vessel containing a suitable leak test liquid. There should be sufficient test liquid in the vacuum vessel so that when immersed, the fuze will be at least 25.4 mm (1 in) below the liquid level. Place the fuze on the elevating platform in the raised position. Buoyant fuzes shall be secured to the platform. Close the vessel and reduce the pressure in the air space above the liquid surface to a value dependent on the subsequent depth of the test fuze. The air pressure value is chosen so that when the fuze is immersed, the total external pressure on the fuze resulting from the air space pressure, and the pressure from the test liquid head is less than prevailing ambient pressure. If the depth of water on the fuze is less than 127 mm (5 in) at it deepest, then a reduction in air pressure of 10 mm Hg (0.39 in Hg) is sufficient. Ten mm of mercury is equal to 137 mm (5.4 in) of water. Then quickly and completely immerse the fuze in the test liquid by lowering the platform. Reduce the pressure of the air space above the liquid to 600 ± 10 mm Hg (23.6 ± 0.39 in Hg) absolute, and hold constant during the observation period of two minutes. A steady stream or recurring succession of small bubbles from the fuze indicates leakage. If large bubbles are observed at any time, the test must be immediately concluded. After the observation period, lift the fuze clear of the test liquid, and then allow the air pressure above the liquid to return to atomspheric. Retrieve the fuze from the vessel, and remove its surface liquid by blowing, blotting, or air drying.

5.2.2 Volume-sharing method. The volume-sharing leak test method may be appropriate for testing fuzes when some question of test liquid compatibility with

TEST E5

SIMULATED PARACHUTE AIR DELIVERY

1. PURPOSE

This is a field safety and reliability test simulating air delivery of packaged fuzes or fuzed munitions. The fuzes must withstand the forces encountered in low-velocity, high-velocity (if required) and malfunctioning air delivery drops.

2. DESCRIPTION

2.1 General. In this test, packaged fuzes and those assembled to warheads or complete rounds are subjected to impacts encountered in low-velocity, high-velocity and malfunctioning parachute delivery.

2.1.1 Low-velocity simulation. Fuzes are subjected to an impact velocity of 8.7 m/s (28.5 ft/s).

2.1.2 Malfunctioning drop simulation. Fuzes are subjected to an impact velocity of 45.7 m/s (150 ft/s).

2.1.3 High-velocity drop simulation (if required). Fuzes are subjected to an impact velocity of 27.4 m/s (90 ft/s).

2.2 Fuze configuration. The fuzes are tested in their standard package, unit or bulk, or assembled to associated munitions. All explosive elements are present in the fuze during the test. Warheads and other components may be inertly loaded.

2.3 Number of drops. Each test article is dropped once per impact orientation of nose up, nose down and sideways.

2.4 Applicable publications. All standards, specifications, drawings, procedures and manuals which form a part of this test are listed in Section 2 of the introduction to this standard.

2.5 Test documentation. Test plans, performance records, equipment, conditions, results, and analysis shall be documented in accordance with Section 4.8 of the general requirements to this standard.

3. CRITERIA FOR PASSING TEST

3.1 Low-velocity and high-velocity test. At the completion of this test, the fuzes shall be safe for transportation, storage, handling and use, as well as operable in accordance with Paragraphs 4.6.2.1a and 4.6.2.2 of the general requirements to this standard.

3.2 Malfunctioning test. At the completion of this test, the fuzes shall be safe for disposal in accordance with Paragraph 4.6.2.1b of the general requirements to this standard.

3.3 Decision basis. Breakdown, inspection, other appropriate tests and engineering judgment shall form the basis for the decision that fuzes have passed or failed the test.

4. *EQUIPMENT*

4.1 Drop tower. A suitable drop tower, boom arrangement or crane with quick-release mechanism may be used for free fall drops.

4.2 Acceleration device. A suitable acceleration device may be used to achieve the specified impact velocity in the malfunctioning drop.

4.3 Impact surface. An impact area of compact soil or level hard surface shall be used.

4.4 Test articles. Fuzes, warheads, or complete rounds in packaged condition shall be used in quantities specified by the test directive.

4.5 Rigging. Standard air delivery rigging equipment, including containers, platforms, and energy absorbers shall be used as required. Retardation devices such as a pilot parachute may be used to ensure the item will impact at the desired orientation and at the required impact velocity.

4.6 Ancillary equipment. Photographic, radiographic, telemetry and disassembly equipment shall be used as required.

5. PROCEDURE

Note: An acceleration device may be used in lieu of free fall to obtain the impact velocity.

5.1 Rigging test articles. Prepare the air delivery system to be dropped by stacking packaged fuzes or fuzes assembled to warheads or complete rounds in the normally shipped orientation. Stacking shall be in accordance with the test directive. Dummy components may be used as partial loading to simulate fuzes or other ammunition components. The rigging instructions shall be specified in the test directive. An example is shown in Figure E5-1.

5.2 Low-velocity test. Release the air delivery system to impact at a minimum velocity of 8.7 m/s (28.5 ft/s) on compact soil or a level hard surface and impacting with the energy absorber on the underside of the load to simulate a low-velocity parachute delivery.

5.3 Malfunctioning test. Release the air delivery system to impact at a minimum velocity of 45.7 m/s (150 ft/s) onto compact soil or a level hard surface to simulate the malfunction velocity in the parachute delivery.

5.4 High-velocity test. See Section 6.2.

5.5 Disassembly. Disassemble the air delivery system. Determine by means of radiographic examination and disassembly or other appropriate methods whether the fuzes have been armed or functioned and are safe to handle. For fuzes subjected to the low-velocity drop, use suitable tests to determine operability.

6. ALTERNATE AND OPTIONAL TESTS

6.1 System without energy absorbers. Alternatively, drop an air delivery system without energy absorbers and without stabilization to impact at a velocity between 24.4 m/s (80 ft/s) and 30.5 m/s (100 ft/s) in the most vulnerable attitude onto a hard surface, such as steel or concrete as a means of determining minimum damage and hazards to be expected in a malfunctioning parachute delivery.

6.2 High-velocity test. Although no formal requirement exists for high impact velocities in the range of 21 to 27.4 m/s (70 to 90 ft/s), it is tactically desirable to deliver fuzes and ammunition in this range of vertical impact velocities. If fuzes and components are satisfactory as tested in Paragraphs 5.2 and 5.3, above, it is suggested that a system drop be made to impact at high-velocity using rigging instructions specified in the test directive. Fuzes and components should be safe to handle and use and be operable in accordance with Paragraph 3.1.

7. RELATED INFORMATION

7.1 Journal Article Serial Number 40 of the JANAF Fuze Committee, "Air Delivery of Ammunition and Explosives by Parachute," 1 September 1965.

7.2 AR 705-35, Criteria for Air Portability and Air Drop of Materiel, 20 October 1967.

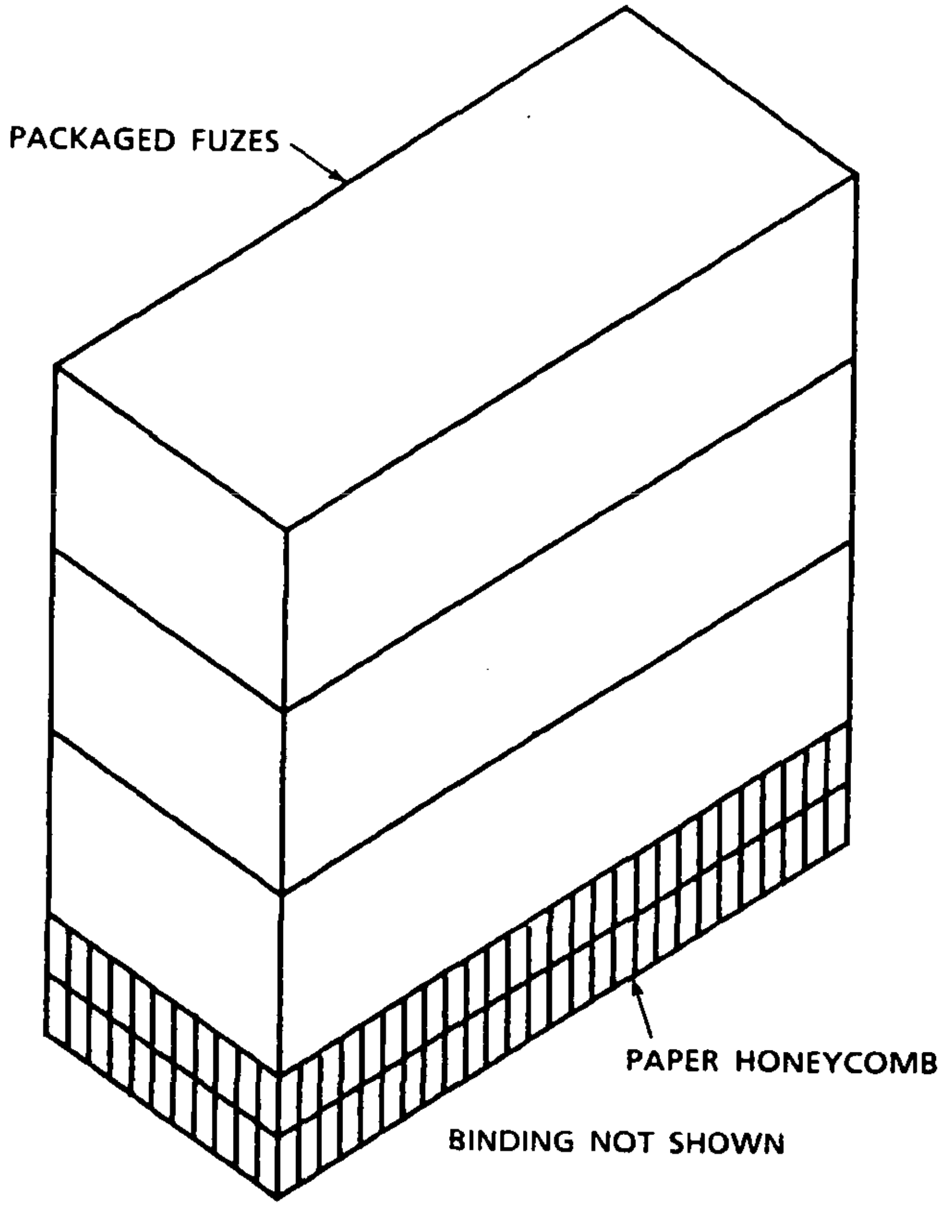

Figure E5-1. Example of Simulated Load.